Appendix A
Tables

A.1 Bases and Transforms of Set Functions

	Transform	Basis
Möbius	$m^{\xi}(S) = \sum_{T \subseteq S} (-1)^{\lvert S \setminus T \rvert} \xi(T)$	$u_T(S) = \begin{cases} 1, & \text{if } S \supseteq T \\ 0, & \text{otherwise} \end{cases}$
Co-Möbius (commonality)	$\check{m}^{\xi}(S) = \sum_{T \supseteq X \setminus S} (-1)^{n-\lvert T \rvert} \xi(T)$	$\check{u}_T(S) = \begin{cases} (-1)^{\lvert T \rvert}, & \text{if } S \cap T = \varnothing \\ 0, & \text{otherwise} \end{cases}$
Conjugate unanimity games	$\overline{U}^{\xi}(S) = (-1)^{\lvert S \rvert + 1} \sum_{T \supseteq X \setminus S} (-1)^{n-\lvert T \rvert} \xi(T)$	$\overline{u_T}(S) = \begin{cases} 1, & \text{if } S \cap T \neq \varnothing \\ 0, & \text{otherwise.} \end{cases}$
Shapley interaction	$I^{\xi}(S) = \sum_{K \subseteq X} \frac{\lvert X \setminus (S \cup K) \rvert ! \lvert K \setminus S \rvert !}{(n-s+1)!} (-1)^{\lvert S \setminus K \rvert} \xi(K)$	$b_T^I(S) = \beta^{\lvert T \rvert}_{\lvert T \cap S \rvert}$
Banzhaf interaction	$I_{\mathrm{B}}^{\xi}(S) = \left(\frac{1}{2}\right)^{n-s} \sum_{K \subseteq X} (-1)^{\lvert S \setminus K \rvert} \xi(K)$	$b_T^{I_B}(S) = \left(\frac{1}{2}\right)^{\lvert T \rvert} (-1)^{\lvert T \setminus S \rvert}$
Fourier	$F^{\xi}(S) = \widehat{\xi}(S) = \frac{1}{2^n} \sum_{K \subseteq X} (-1)^{\lvert S \cap K \rvert} \xi(K)$	$b_T^F(S) = \chi_T(S) = (-1)^{\lvert S \cap T \rvert}$
Walsh	$W^{\xi}(S) = \frac{1}{2^n} \sum_{K \subseteq X} (-1)^{\lvert S \setminus K \rvert} \xi(K)$	$w_T(S) = (-1)^{\lvert T \setminus S \rvert}$
Yokote ($T \neq \varnothing$)	$Y^{v}(S) = \sum_{L \subseteq X} (-1)^{\lvert S \cap L \rvert + 1} \frac{(n-s-l)!(s+l-1)!}{n!} v(L)$	$\upsilon_T(S) = \begin{cases} 1, & \text{if } \lvert S \cap T \rvert = 1 \\ 0, & \text{otherwise} \end{cases}$

Table A.1 Linear invertible transforms and their associated bases

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A.2 Conversion Formulae Between Transforms

We summarize all formulas established in Chap. 2 for passing from one representation of a set function ξ to another. The readers can also consult [178], where all conversion formulae between the Möbius, co-Möbius, interaction and Banzhaf interaction transforms are proved (Tables A.2, A.3, A.4, and A.5).

The superscript $\cdot^{\xi}$ is omitted in $m, \check{m}$, etc. Cardinality of sets are indicated in corresponding small letters. We recall that $|X| = n$.

	ξ	m	$\check{m}$
$\xi(A) =$	$\xi(A)$	$\sum_{B\subseteq A} m(B)$	$\sum_{B\subseteq X\setminus A} (-1)^b \check{m}(B)$
$m(A) =$	$\sum_{B\subseteq A} (-1)^{a-b}\xi(B)$	$m(A)$	$\sum_{B\supseteq A} (-1)^{b-a}\check{m}(B)$
$\check{m}(A) =$	$\sum_{B\supseteq X\setminus A} (-1)^{n-b}\xi(B)$	$\sum_{B\supseteq A} m(B)$	$\check{m}(A)$
$I(A) =$	$\sum_{B\subseteq X} \frac{(-1)^{\lvert A\setminus B\rvert}}{(n-a+1)\binom{n-a}{\lvert B\setminus A\rvert}}\xi(B)$	$\sum_{B\supseteq A} \frac{1}{b-a+1} m(B)$	$\sum_{B\supseteq A} \frac{(-1)^{b-a}}{b-a+1}\check{m}(B)$
$I_{\mathrm{B}}(A) =$	$\left(\frac{1}{2}\right)^{n-a} \sum_{B\subseteq X} (-1)^{\lvert A\setminus B\rvert}\xi(B)$	$\sum_{B\supseteq A} \left(\frac{1}{2}\right)^{b-a} m(B)$	$\sum_{B\supseteq A} \left(-\frac{1}{2}\right)^{b-a}\check{m}(B)$

Table A.2 Conversion formulae between $\xi, m, \check{m}, I$, and I_{B}

	I	I_{B}
$\xi(A) =$	$\sum_{D\subseteq X} \beta^d_{\lvert A\cap D\rvert} I(D)$	$\sum_{B\subseteq X} \left(\frac{1}{2}\right)^b (-1)^{\lvert B\setminus A\rvert} I_{\mathrm{B}}(B)$
$m(A) =$	$\sum_{B\supseteq A} B_{a-b} I(B)$	$\sum_{B\supseteq A} \left(-\frac{1}{2}\right)^{b-a} I_{\mathrm{B}}(B)$
$\check{m}(A) =$	$\sum_{B\supseteq A} (-1)^{b-a} B_{b-a} I(B)$	$\sum_{B\supseteq A} \left(\frac{1}{2}\right)^{b-a} I_{\mathrm{B}}(B)$
$I(A) =$	$I(A)$	$\sum_{B\supseteq A} \frac{1+(-1)^{b-a}}{(b-a+1)2^{b-a+1}} I_{\mathrm{B}}(B)$
$I_{\mathrm{B}}(A) =$	$\sum_{B\supseteq A} \left(\frac{1}{2^{b-a-1}} - 1\right) B_{b-a} I(B)$	$I_{\mathrm{B}}(A)$

Table A.3 Conversion formulae between $\xi, m, \check{m}, I$, and I_{B} (ctd')

Relations between the Fourier, Banzhaf interaction and Walsh transforms:

$$\widehat{\xi}(A) = \left(\frac{-1}{2}\right)^a I^{\xi}_{\mathrm{B}}(A) = (-1)^a W(A)$$

	ξ	m	$\widehat{\xi}$
$\xi(A) =$	$\xi(A)$	$\sum_{B\subseteq A} m(B)$	$\sum_{B\subseteq X}(-1)^{\lvert A\cap B\rvert}\widehat{\xi}(B)$
$m(A) =$	$\sum_{B\subseteq A}(-1)^{a-b}\xi(B)$	$m(A)$	$(-2)^a\sum_{B\supseteq A}\widehat{\xi}(B)$
$\widehat{\xi}(A) =$	$\frac{1}{2^n}\sum_{B\subseteq X}(-1)^{\lvert A\cap B\rvert}\xi(B)$	$(-1)^a\sum_{B\supseteq A}\frac{1}{2^b}m(B)$	$\widehat{\xi}(A)$

Table A.4 Conversion formulae between ξ, m and $\widehat{\xi}$

	v	m	Y
$v(A) =$	$v(A)$	$\sum_{B\subseteq A} m(B)$	$\sum_{B\,:\,\lvert B\cap A\rvert=1} Y(B)$
$m(A) =$	$\sum_{B\subseteq A}(-1)^{a-b}v(B)$	$m(A)$	$a(-1)^{a+1}\sum_{B\supseteq A} Y(B)$
$Y(A) =$	$\sum_{B\subseteq X}(-1)^{\lvert A\cap B\rvert+1}\frac{(n-a-b)!(a+b-1)!}{n!}v(B)$	$(-1)^{a+1}\sum_{B\supseteq A}\frac{1}{b}m(B)$	$Y(A)$

Table A.5 Conversion formulae between v, m and Y. These formulae are valid for games only

List of Symbols

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